

10/10 Recd PCT/PTO 29 JAN 2002

FORM PTO-1390		U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE	ATTORNEY'S DOCKET NUMBER 50215-047
TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371			U.S. APPLIC. NO. (if known, see 37 CFR 1.5) 10/048169
INTERNATIONAL APPLICATION NO. PCT/IB00/01048	INTERNATIONAL FILING DATE July 27, 2000	PRIORITY DATE CLAIMED July 29, 1999	
TITLE OF INVENTION THERMAL SPRAYING EQUIPMENT			
APPLICANTS FOR DO/EO/US Michael Walter SEITZ			
Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information.			
1.	<input checked="" type="checkbox"/>	This is a FIRST submission of items concerning a filing under 35 U.S.C. 371.	
2.	<input type="checkbox"/>	This is a SECOND or SUBSEQUENT submission of items concerning a filing under 35 U.S.C. 371	
3.	<input checked="" type="checkbox"/>	This express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1).	
4.	<input checked="" type="checkbox"/>	A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.	
5.	<input checked="" type="checkbox"/>	A copy of the International Application as filed (35 U.S.C. 371(c)(2)) a <input type="checkbox"/> is transmitted herewith (required only if not transmitted by the International Bureau). b <input checked="" type="checkbox"/> has been transmitted by the International Bureau. (Enclosed herewith is a copy of the Published International Application.) c <input type="checkbox"/> is not required, as the application was filed in the United States Receiving Office (RO/US)	
6.	<input checked="" type="checkbox"/>	A translation of the International Application into English (35 U.S.C. 371(c)(2))	
7.	<input type="checkbox"/>	Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3)) a <input type="checkbox"/> are transmitted herewith (required only if not transmitted by the International Bureau). b <input type="checkbox"/> have been transmitted by the International Bureau c <input type="checkbox"/> have not been made; however, the time limit for making such amendment has NOT expired. d <input type="checkbox"/> have not been made and will not be made.	
8.	<input type="checkbox"/>	A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3))	
9.	<input type="checkbox"/>	An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4))	
10.	<input type="checkbox"/>	A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).	
Items 11. to 16. below concern other document(s) or information included:			
11.	<input checked="" type="checkbox"/>	An Information Disclosure Statement under 37 CFR 1.97 and 1.98.	
12.	<input type="checkbox"/>	An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.	
13.	<input checked="" type="checkbox"/>	A FIRST preliminary amendment. <input type="checkbox"/> A SECOND or SUBSEQUENT preliminary amendment.	
14.	<input type="checkbox"/>	A substitute specification	
15.	<input type="checkbox"/>	A change of power of attorney and/or address letter.	
16.	<input checked="" type="checkbox"/>	Other items or information. 1. International Search Report prepared by EPO. 2. Published International Application 3. International Preliminary Examination Report. 4. Amended Claims. 5. APPLICANT IS ENTITLED TO CLAIM SMALL ENTITY STATUS.	



20277

PATENT TRADEMARK OFFICE

U.S. APPLIC. NO (if known, see 37 CFR 1.50) <div style="font-size: 1.5em; font-weight: bold;">10/048169</div>		INTERNATIONAL APPLICATION NO PCT/IB00/01048		ATTORNEY'S DOCKET NUMBER 50214-047	
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				CALCULATIONS	PTO USE ONLY
17. <input checked="" type="checkbox"/> The following fees are submitted: <div style="margin-left: 20px;"> Basic National Fee (37 CFR 1.492(a)(1)-(5)): Search Report has been prepared by the EPO or JPO \$890.00 International preliminary examination fee paid to USPTO (37 CFR 1.482) \$710.00 No international preliminary examination fee paid to USPTO (37 CFR 1.482) but international search fee paid to USPTO (37 CFR 1.445(a)(2)) \$740.00 Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO \$1,040.00 International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(2)-(4) \$100.00 </div> <div style="text-align: right; margin-top: 10px;"> ENTER APPROPRIATE BASIC FEE AMOUNT = </div>					
Surcharge of \$130.00 for furnishing the oath or declaration later than <input type="checkbox"/> 20 <input checked="" type="checkbox"/> 30 months from the earliest claimed priority date (37 CFR 1.492(e)).				\$ 130.00	
Claims	Number Filed	Number Extra	Rate		
Total Claims	15 -20 =	0	x \$18.00	\$0.00	
Independent Claims	1 -3 =		x \$84.00	\$ 0.00	
Multiple dependent claim(s) (if applicable)			+ \$280.00	\$ 280.00	
TOTAL OF ABOVE CALCULATIONS =				1,300.00	
Reduction by 1/2 for filing by small entity, if applicable. Verified Small Entity Statement must also be filed. (Note 37 CFR 1.9, 1.27, 1.28).				\$ 650.00	
SUBTOTAL =				\$ 650.00	
Processing fee of \$130.00 for furnishing the English translation later than the <input type="checkbox"/> 20 <input type="checkbox"/> 30 months from the earliest claimed priority date (37 CFR 1.492(f)).				\$ 0.00	
TOTAL NATIONAL FEE =				\$ 650.00	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). \$40.00 per property				\$ 0.00	
TOTAL FEES ENCLOSED =				\$0.00	
				Amount to be refunded	\$
				charged	\$ 650.00

a. ☐ A check in the amount of \$ _____ to cover the above fees is enclosed.

b. ☒ Please charge my Deposit Account No. 500417 in the amount of \$ 650.00 to cover the above fees. A duplicate copy of this sheet is enclosed.

c. ☒ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 500417. A duplicate copy of this sheet is enclosed.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:

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REGISTRATION NUMBER	January 29, 2002

Docket No.: 50214-047

10/048169

PATENT

JC13 Rec'd PCT/PTO 29 JAN 2002

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of :
Michael Walter SEITZ :
Serial No.: : Group Art Unit:
Filed: January 29, 2002 : Examiner:
For: THERMAL SPRAYING EQUIPMENT

PRELIMINARY AMENDMENT

Commissioner for Patents
Washington, DC 20231

Sir:

Prior to examination of the above-referenced application, please amend the application as follows:

IN THE CLAIMS:

Please replace the attached amended claims 1-11, with the original claims 1-12, as filed.

REMARKS

The above-referenced application has been amended to replace the attached amended claims 1-11, with the original claims 1-12, as filed. Attached hereto is a clean copy of the amended claims. Entry of this preliminary amendment is respectfully requested.

Respectfully submitted,

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CLAIMS:

1. Thermal spraying apparatus comprising a nozzle defining a throat having an inlet and an outlet and a gas flow path which is aligned with the axis of the throat, so that gas under pressure can be supplied to the inlet, at least first and second guides arranged to guide respective feedstock wires via the inlet towards a point of intersection in or adjacent an end of the throat; a power supply arranged to be connected to the feedstock wires to cause an arc in the throat between the wires; and a supply of compressed air arranged to supply air to the throat, wherein the nozzle is formed from first and second body halves, each defining a portion of the throat.
2. Thermal spraying apparatus according to claim 1 wherein the guides are arranged to direct the feedstock wires to the point of intersection so that they define an angle of between 45° and 90° between them.
3. Thermal spraying apparatus according to claim 1 or claim 2 wherein the guides comprise respective bores formed in the body halves and each intersecting the portion of the body half defining a respective portion of the throat, each bore being inclined relative to the axis of the throat.
4. Thermal spraying apparatus according to claim 3 wherein the guides include inserts receivable in the respective bores, each insert having an aperture therein through which a feedstock wire can pass, and having an inclined end face shaped complementally to the shape of the throat.
5. Thermal spraying apparatus according to claim 3 wherein the respective bores intersect locating cavities, inserts being receivable in

AMENDED SHEET

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the locating cavities so that they abut feedstock wires passing through the respective bores.

6. Thermal spraying apparatus according to claim 5 wherein the inserts are polygonal in section and define planar faces each having a locating formation for engagement with a feedstock wire in use.
7. Thermal spraying apparatus according to claim 6 wherein the inserts are square in section and define planar, rectangular faces with a groove formed in at least one face for engagement with a feedstock wire in use.
8. Thermal spraying apparatus according to any one of claims 4 to 7 wherein the inserts comprise copper or copper/tungsten.
9. Thermal spraying apparatus according to any one of claims 1 to 8 wherein the body halves are conductive, with a terminal or contact on each body half for connection to the power supply.
10. Thermal spraying apparatus according to claim 9 wherein the body halves are mounted on a non-conductive head which holds the body halves in a spaced-apart condition.
11. Thermal spraying apparatus according to any one of the preceding claims wherein the throat is rectangular in cross section.

AMENDED SHEET

** TOTAL PAGE.28 **

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THERMAL SPRAYING EQUIPMENT

BACKGROUND OF THE INVENTION

THIS invention relates to thermal spraying equipment and to a thermal spraying method for producing corrosion resistant and/or hard coatings on a substrate.

International patent application no. WO 98/00574 describes a thermal spraying method and apparatus of the above general kind.

It is an object of the invention to provide a method and apparatus which is a development of the known method and apparatus.

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SUMMARY OF THE INVENTION

According to the invention there is provided thermal spraying apparatus comprising a nozzle defining a throat having an inlet and an outlet and a gas flow path which is aligned with the axis of the throat, so that gas under pressure can be supplied to the inlet; at least first and second guides arranged to guide respective feedstock wires via the inlet towards a point of intersection in or adjacent an end of the throat; a power supply arranged to be connected to the feedstock wires to cause an arc in the throat between the wires; and a supply of compressed air arranged to supply air to the throat, the guides being arranged to direct the feedstock wires to the point of intersection so that they define an angle of between 45° and 90° between them.

Preferably, the guides are arranged so that the angle defined between the feedstock wires is approximately 60°.

The nozzle may be formed from first and second body halves, each defining a portion of the throat. Typically the throat is tapered between the inlet and the outlet.

The guides may comprise respective bores formed in the body halves and each intersecting the portion of the body half defining a respective portion of the throat, each bore being inclined relative to the axis of the throat.

The guides may include inserts receivable in the respective bores, each insert having an aperture therein through which a feedstock wire can pass, and having an inclined end face shaped complementally to the shape of the throat.

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Alternatively, the respective bores may intersect locating cavities, inserts being receivable in the locating cavities so that they abut feedstock wires passing through the respective bores.

The inserts may be polygonal in section and define planar faces each having a locating formation for engagement with a feedstock wire in use.

Preferably, the inserts are square in section and define planar, rectangular faces with a groove formed in at least one face for engagement with a feedstock wire in use.

The inserts may comprise copper or copper/tungsten.

The body halves are preferably conductive, with a terminal or contact on each body half for connection to the power supply.

The body halves are preferably mounted on a non-conductive head which holds the body halves in a spaced-apart condition.

BRIEF DESCRIPTION OF THE DRAWINGS

- Figure 1** is an exploded view of a first embodiment of a spray head of thermal spraying apparatus according to the invention;
- Figure 2** is a pictorial view of the apparatus of Figure 1;
- Figure 3** is a rear end view of the apparatus of Figure 1;
- Figure 4** is a section on the line 4-4 in Figure 3;

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Figure 5 is a partial exploded view of a second embodiment of a spray head of the apparatus; and

Figure 6 is a sectional view of the second embodiment of the spray head.

DESCRIPTION OF EMBODIMENTS

The apparatus illustrated in Figures 1 to 4 comprises a thermal spraying head which is connected in use to a source of compressed air or nitrogen by means of a hose 10, and to a high current power supply 12 in use.

The general principle of operation of the apparatus is substantially similar to that described in the abovementioned international patent application no. WO 98/00574, the contents of which are incorporated herein by reference.

The spray head of the apparatus comprises first and second conductive body halves 14 and 16 which are machined from aluminium alloy and which are mounted on a non-conductive head 18 which can, for example, be moulded or machined from a suitable plastics material such as PTFE.

As shown in the exploded view of Figure 1, the body halves 14 and 16 are attached to the head 18 hingedly by means of pins, which assist in assembly of the head and in correct location of the body halves with respect to one another. An outer sleeve 56 of tough plastics material such as nylon holds the body halves in position and is located positively by a pin 58.

The front face of the head has a circular central portion 20, at the centre of which is an outlet 22 of a nozzle which has an inlet 24, and a cylindrical throat 26 extending between the inlet and the outlet. The throat is tapered

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from the inlet to the outlet such that it has an inlet diameter of 8mm and an exit diameter of 8.5mm.

Cavities 28 and 30 are machined into the respective body halves 14 and 16, and define respective inclined bores 32 and 34 which intersect with respective grooved portions 36 and 38 of the body halves which define the throat 26, at an angle of approximately 30° to the axis X-X of the throat, so that the included angle between the two bores 34 is 60°.

Locatable within each bore is a copper insert 40, the inserts 40 having ends 42 which are shaped complementally to the grooved surfaces 36 and 38 defining the throat of the nozzle, so that when the inserts are in position in the bores 34, their ends 42 are flush with the surface of the throat. A bore 44 is formed in each insert which is sized to receive a metal feedstock wire 46 and to make electrical contact with the wire as the wire passes through the insert and into the throat 26.

In the prototype apparatus, the feedstock wires 46 were directed to a point of intersection at the outer end of the throat 26 essentially coinciding with the outlet 22 and the central axis X-X of the throat. In some applications, it may be desirable to move the point of intersection outside the throat, although it has been found in practice that it is generally preferred for the point of intersection to be within the throat.

Electrical terminals 48 and 50 on the respective body halves 14 and 16 are provided for connection of heavy duty conductors 52 and 54 which connect the body halves to the power supply 12, and which thus pass current to the feedstock wires 46 via the body halves and the copper inserts, causing an arc at the point of intersection of the feedstock wires in the throat. In the prototype apparatus of the invention, the power supply 12 was a constant voltage source operating at approximately 42 to 48 volts (compared with

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approximately 32 to 36 volts in the case of conventional apparatus). The arc current was between 150 Amperes and 300 Amperes and the gas pressure at the entrance 2 to 5 bar (g), typically 4 bar.

Figures 5 and 6 illustrate a second embodiment of a thermal spraying head according to the invention. The second embodiment is to a large extent similar to the first, and Figure 5 therefore illustrates only a single conductive body half 114, which corresponds to the body half 14 of Figure 1. The body half 114 mates with a complementary body half 116 (see Figure 6) and the halves are assembled to a non-conductive body in the same way as in the first embodiment.

The main difference between the first and second embodiments is that in the latter case, each body half defines a rectangular slot or cavity 118 which receives a contact tip in the form of a removable insert 120. A relatively small bore 122, which is larger in diameter than the diameter of the feedstock wires 124, extends from an upstanding head portion 126 of the body half 114, exiting the head portion 126 at the base thereof, just above the bottom of the cavity 118, and extending further through an end portion 128 of the body half as best seen in the sectional view of Figure 6. The insert 120 has a central groove 134 machined in each of its four adjacent faces, so that the grooves effectively run around the body of the insert. The function of the insert is described in more detail below. As in the first embodiment, the alignment of the bores 122 and the central groove 134 in the insert 120 is such that the feedstock wires 124 intersect at a point just within or just beyond the end 130 of a throat 132 defined between the two body halves.

The throat 132 in this embodiment is a tapered square/rectangular section channel, rather than a conical bore, since this is easier to machine and a round orifice for the outlet is not a prerequisite. The entrance to the throat is 6 mm by 6 mm, with the exit being 6 mm by 7 mm (rectangular).

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The insert 120 serves the same purpose as the copper inserts 40 of the first embodiment, and typically comprises copper or copper/tungsten. A through bore 136 extends through the insert from side to side, and is provided to facilitate storage of the inserts. In the prototype, the insert was approximately 20 mm in length in the direction of the through bore 136, and the faces thereof were 12 mm square with the grooves 134 being approximately 1mm deep. Dimples 138 are provided on each face on either side of the central groove, and serve as locators for locking balls or grub screws 140 as shown in Figures 5 and 6.

As mentioned above, the feedstock wires 124 lie within the grooves 134 in use (see Figure 6), with the insert providing the force which directs the feedstock wire to its point of intersection, thus providing sufficiently good electrical contact between the feedstock wire and the insert.

The above described inserts have a number of advantages over the tubular inserts 40 of the first embodiment. Firstly, each insert has four wear surfaces, so that it need only be rotated through 90 degrees to present a fresh surface. This means that the life of the insert is relatively long. It has been found that this insert does not clog as easily as is the case with drilled-hole inserts. The insert is easy to manufacture, and is also easily fitted into the spray gun head from the front thereof.

As described in the abovementioned International patent application, the pressure and volume of the gas supplied to the interior of the nozzle are preferably adjusted to cause sonic or choked gas flow within the throat prior to generation of an arc, so that the generation of an arc within the throat has the effect of generating supersonic flow within or just beyond the exhaust end of the nozzle, which would otherwise not be attainable. The resultant high flow velocity results in very fine atomisation of the molten feedstock particles

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and very high particle speeds as the particles are emitted from the nozzle towards a substrate.

It has been found that by using a flow of gas which is sonic or supersonic and positioning the arc in the area of supersonic or sonic flow, the most effective results are obtained.

Due to the very high temperature of the arc (typically 4000°C) the arc rapidly heats and drastically expands the gas entering the arc. This rapid expansion effectively acts as a gas source in the flow field, effectively blocking the flow of gas through the arc. Due to this blockage effect, the gas tends to flow around the "obstruction", similarly to the way water flows around a concrete pillar of a bridge.

When a supersonic gas flow exists, the gas flowing towards the "obstruction" (the arc) is not "aware" of the arc until it actually enters the arc zone and the gas is thereby forced into the arc region. The resulting high pressure, high flow situation results in very fine atomisation of the molten feedstock. Thus, where a supersonic basic gas flow is used, the arc can be positioned anywhere along the throat, up to and including the exit region of the throat and just beyond it. In the case of a supersonic output spray, the exhausting flow has a diamond shaped supersonic flow field structure.

The feedstock wires 46 can be conventional solid wires, but it has been found that the use of cored wires comprising a tubular metallic body containing a cermet powder, together with the use of nitrogen or another suitable inert gas, provides excellent results. The cermet material, typically an agglomerated and sintered mix of metal and carbide, tends to improve the deposition of carbide material from the thermal spray method, as the hard carbide material is contained within a metal binder. Use of pure nitrogen or another suitable inert gas protects the atomised metal feedstock particles

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from oxidation, significantly improving the quality of the coating produced.

It has been found that utilising relatively short spray distances between the outlet of the nozzle and the substrate to be coated, preferably less than 100 mm and down to as little as 5 mm, further reduces the formation of oxides which detrimentally effect the quality of the coating. In prior art devices, short spraying distances can lead to overheating of the substrate, but due to the very high gas flow through the spray device of the invention, the gas jet has a cooling effect, preventing overheating.

It is believed that the use of a relatively steep angle of intersection between the feedstock wires of at least 45°, and typically 60°, compared with the conventional angle of intersection of approximately 30°, ensures that the ends of the feedstock wires at the point of generation of the arc are more stable in the high velocity gas stream in the throat, and that the atomisation of the molten metal resulting from the arc is more uniform due to the smaller exposed surface cross section of the feedstock wires. In this regard, the design of the wire guides so as not to protrude into the throat and therefore not to disturb the gas flow in the throat is also important.

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CLAIMS:

1. Thermal spraying apparatus comprising a nozzle defining a throat having an inlet and an outlet and a gas flow path which is aligned with the axis of the throat, so that gas under pressure can be supplied to the inlet; at least first and second guides arranged to guide respective feedstock wires via the inlet towards a point of intersection in or adjacent an end of the throat; a power supply arranged to be connected to the feedstock wires to cause an arc in the throat between the wires; and a supply of compressed air arranged to supply air to the throat, wherein the nozzle is formed from first and second body halves, each defining a portion of the throat.
2. Thermal spraying apparatus according to claim 1 wherein the guides are arranged to direct the feedstock wires to the point of intersection so that they define an angle of between 45° and 90° between them.
3. Thermal spraying apparatus according to claim 1 or claim 2 wherein the guides comprise respective bores formed in the body halves and each intersecting the portion of the body half defining a respective portion of the throat, each bore being inclined relative to the axis of the throat.
4. Thermal spraying apparatus according to claim 3 wherein the guides include inserts receivable in the respective bores, each insert having an aperture therein through which a feedstock wire can pass, and having an inclined end face shaped complementally to the shape of the throat.
5. Thermal spraying apparatus according to claim 3 wherein the respective bores intersect locating cavities, inserts being receivable in

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the locating cavities so that they abut feedstock wires passing through the respective bores.

6. Thermal spraying apparatus according to claim 5 wherein the inserts are polygonal in section and define planar faces each having a locating formation for engagement with a feedstock wire in use.
7. Thermal spraying apparatus according to claim 6 wherein the inserts are square in section and define planar, rectangular faces with a groove formed in at least one face for engagement with a feedstock wire in use.
8. Thermal spraying apparatus according to any one of claims 4 to 7 wherein the inserts comprise copper or copper/tungsten.
9. Thermal spraying apparatus according to any one of claims 1 to 8 wherein the body halves are conductive, with a terminal or contact on each body half for connection to the power supply.
10. Thermal spraying apparatus according to claim 9 wherein the body halves are mounted on a non-conductive head which holds the body halves in a spaced-apart condition.
11. Thermal spraying apparatus according to any one of the preceding claims wherein the throat is rectangular in cross section.

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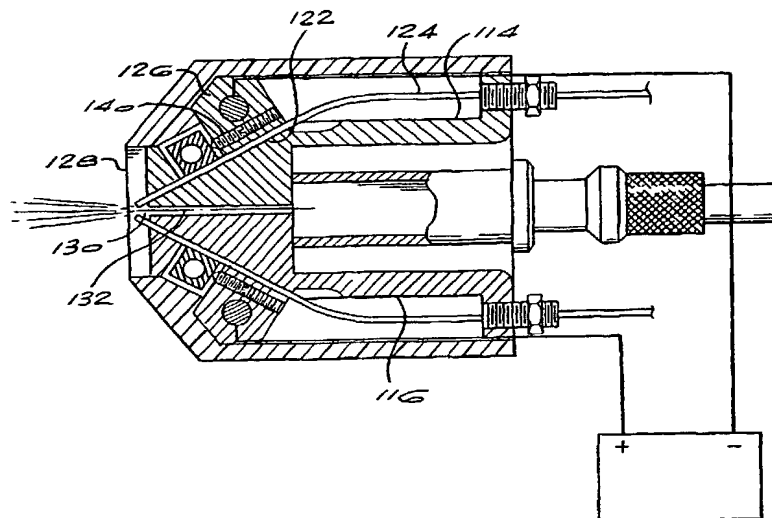
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Published:

— With international search report.

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: THERMAL SPRAYING EQUIPMENT



(57) Abstract: Thermal spraying apparatus comprises a spray head defining a nozzle with a throat (132) through which gas under pressure can be supplied. First and second guides are provided to guide feedstock wires (124) towards a point of intersection in or adjacent an end of the throat, preferably at an angle of between 45 and 90 degrees. The gas is forced through the throat at high pressure, preferably at a pressure sufficient to cause supersonic flow, thereby generating a finely atomised spray of molten feedstock material. The feedstock guides can take the form of drilled tubular inserts, or inserts with grooves which are received in cavities in body halves of the spray head.

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FIG 1

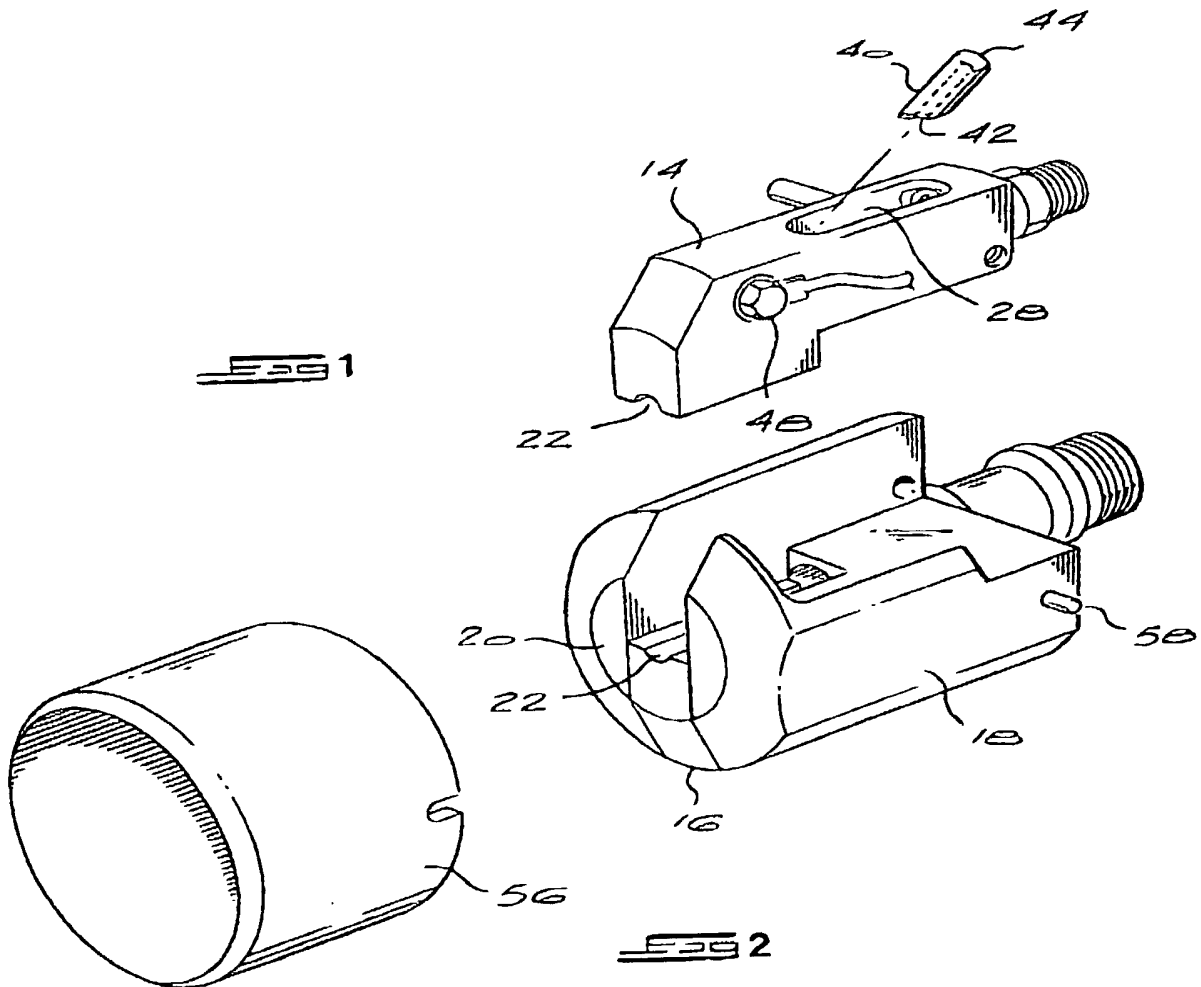
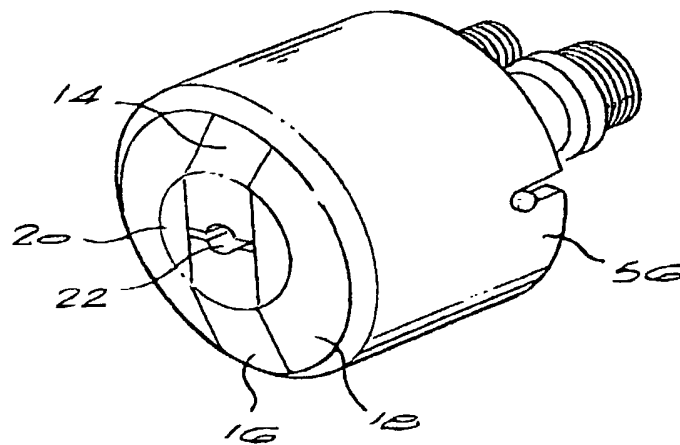
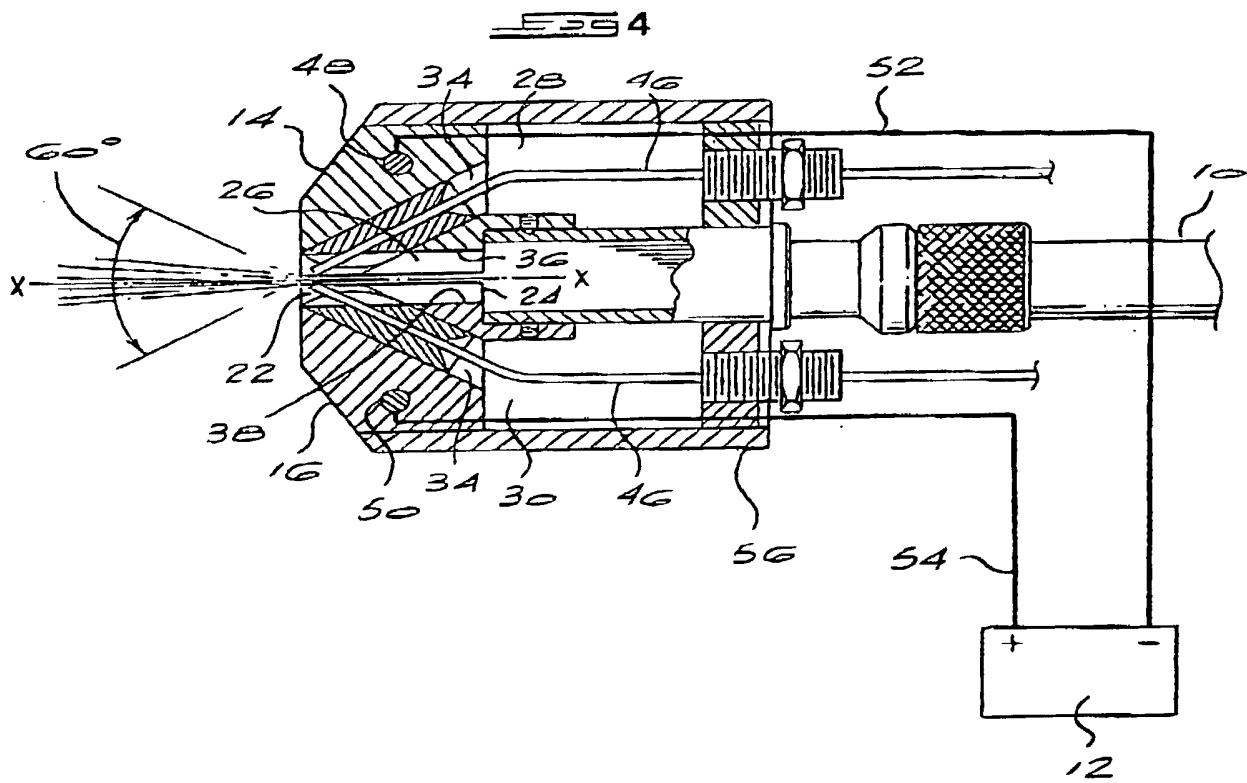
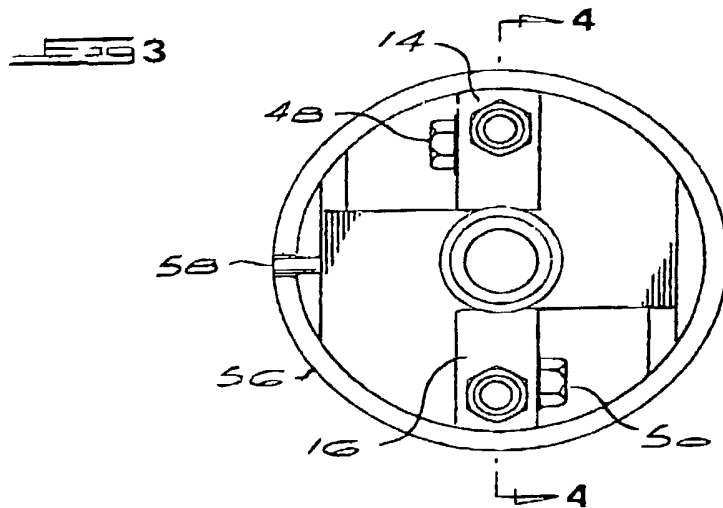
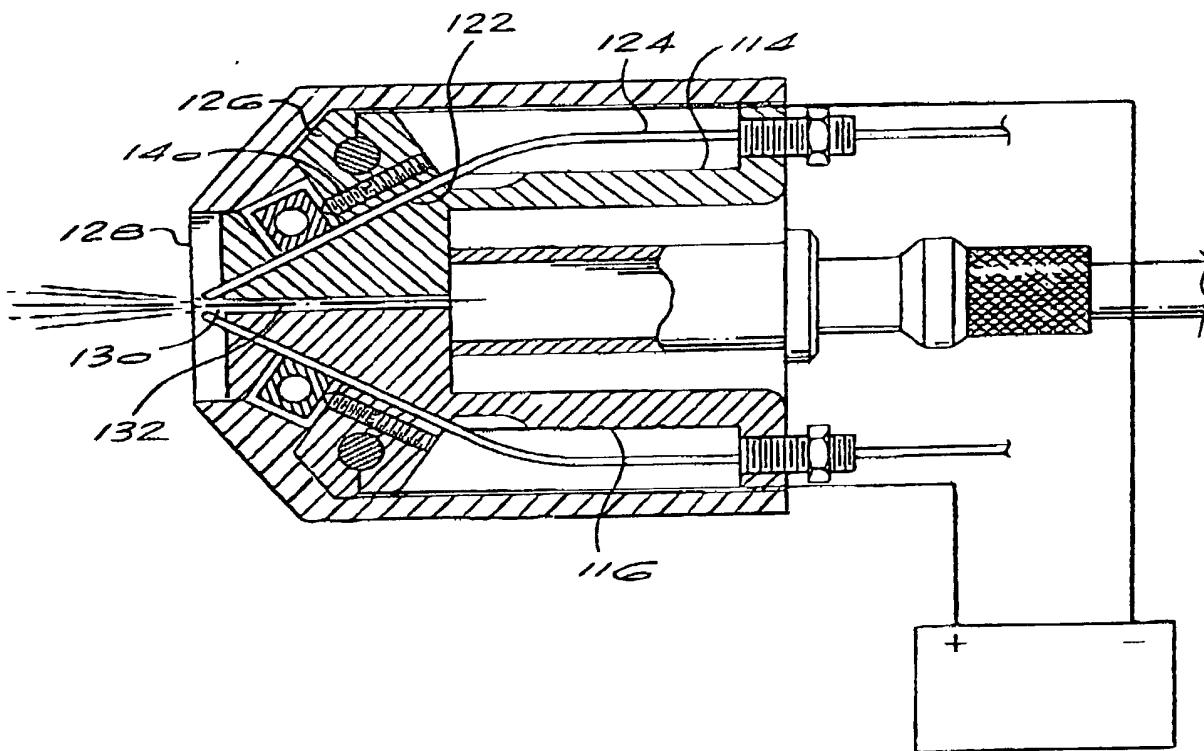
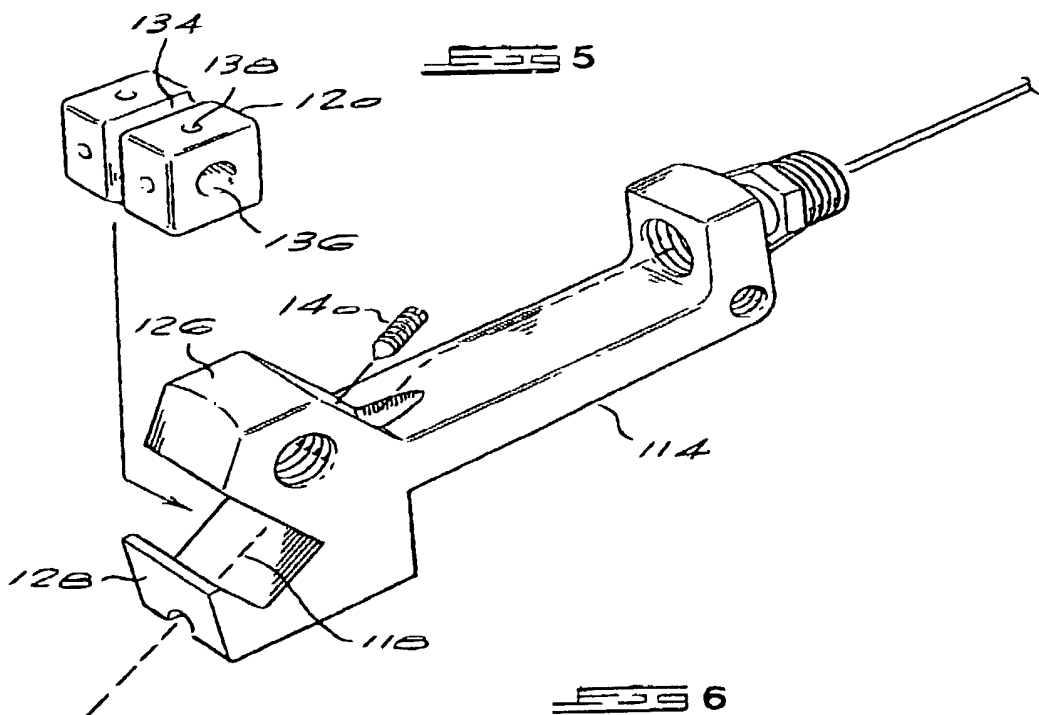


FIG 2



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COMBINED DECLARATION FOR PATENT APPLICATION AND POWER OF ATTORNEY

Attorney's Docket Number

(Includes Reference to PCT International Application(s))

As below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled: **THERMAL SPRAYING EQUIPMENT**

the specification of which:

☐ is attached hereto.☒ was filed as United States application Serial No. 10/048,169on January 29, 2002

and was amended on _____ (if applicable).

☐ was filed as PCT international application Number _____

on _____

and was amended under PCT Article 19 on _____ (if applicable).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is known to me to be material to patentability in accordance with Title 37, Code of Federal Regulations, §1.56.

I hereby claim foreign priority benefits under Title 35, United States Code, §119(a)-(d) or Section 365(b) of any foreign and/or international application(s) for patent or inventor's certificate or Section 365(a) of any PCT international application(s) designating at least one country other than the United States of America listed below and have also identified below any foreign application(s) for patent or inventor's certificate or any PCT international application(s) designating at least one country other than the United States of America filed by me on the same subject matter having a filing date before that of the application(s) of which priority is claimed:

PRIOR FOREIGN/PCT APPLICATION(S) AND ANY PRIORITY CLAIMS UNDER 35 U.S.C. 119:

COUNTRY (If PCT, indicate "PCT")	APPLICATION NUMBER	DATE OF FILING (day, month, year)	PRIORITY CLAIMED UNDER 35 USC 119
SOUTH AFRICA	99/4887	29 JULY 1999	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No

I hereby claim the benefit under 35 USC §119(e) of any United States provisional application(s) listed below

PRIOR PROVISIONAL APPLICATION(S):

Application Number	Filing Date

I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s), or §365(c) of any PCT international application(s) designating the United States of America that is/are listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in that/those prior application(s) in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, §1.56 which occurred between the filing date of the prior application(s) and the national or PCT international filing date of this application.

PRIOR U.S. APPLICATIONS OR PCT INTERNATIONAL APPLICATIONS DESIGNATING THE U.S. FOR BENEFIT UNDER 35 U.S.C. 120:

U.S. APPLICATIONS		STATUS (Check One)		
U.S. Application Number	U.S. Filing Date	Patented	Pending	Abandoned
PCT APPLICATIONS DESIGNATING THE U.S.				
PCT Application No.	PCT Filing Date	U.S. Serial Numbers Assigned (if any)		
PCT/IB00/01048	27 JULY 2000			

POWER OF ATTORNEY: As named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith: Edward A. Becker, Reg. No. ~~37,777~~; Stephen A. Becker, Reg. No. ~~26,527~~; Marcel K. Bingham, Reg. No. ~~42,327~~; John G. Bisbikis, Reg. No. ~~37,095~~; Carl L. Brandt, Reg. No. ~~44,555~~; Daniel Bucca, Reg. No. ~~42,368~~; Kenneth L. Cage, Reg. No. ~~26,454~~; Stephen C. Carlson, Reg. No. ~~39,929~~; Jennifer Chen, Reg. No. ~~42,404~~; Thomas A. Corrado, Reg. No. ~~42,439~~; Lawrence T. Cullen, Reg. No. ~~44,489~~; Paul Devinsky, Reg. No. ~~28,553~~; Margaret M. Duncan, Reg. No. ~~30,879~~; Brian E. Ferguson, Reg. No. ~~36,801~~; Michael E. Fogarty, Reg. No. ~~36,139~~; John R. Fuisz, Reg. No. ~~37,327~~; Willem F. Gadiano, Reg. No. ~~37,436~~; Keith E. George, Reg. No. ~~34,111~~; Matthew V. Grumbling, Reg. No. ~~44,427~~; John A. Hankins, Reg. No. ~~32,029~~; Brian D. Hickman, Reg. No. ~~35,894~~; Joseph Hyosuk Kim, Reg. No. ~~41,425~~; Eric J. Kraus, Reg. No. ~~36,190~~; Jack Q. Lever, Reg. No. ~~28,149~~; Raphael V. Lupo, Reg. No. ~~28,363~~; Christine F. Martin, Reg. No. ~~39,762~~; Michael A. Messina, Reg. No. ~~33,424~~; Eugene J. Molinelli, Reg. No. ~~42,901~~; Christopher J. Palermo, Reg. No. ~~42,056~~; Dawn L. Palmer, Reg. No. ~~41,238~~; Joseph H. Paquin, Jr., Reg. No. ~~31,647~~; William D. Pegg, Reg. No. ~~42,988~~; Robert L. Price, Reg. No. ~~22,685~~; Thomas D. Robbins, Reg. No. ~~43,669~~; Gene Z. Robinson, Reg. No. ~~33,351~~; Joy Ann G. Serauskas, Reg. No. ~~27,952~~; David A. Spenard, Reg. No. ~~37,449~~; Arthur J. Steiner, Reg. No. ~~26,106~~; David L. Stewart, Reg. No. ~~37,578~~; Michael D. Switzer, Reg. No. ~~39,552~~; Leonid D. Thenor, Reg. No. ~~39,397~~; Keith J. Townsend, Reg. No. ~~40,358~~; Daniel S. Trainor, Reg. No. ~~43,959~~; Cameron K. Weiffenbach, Reg. No. ~~44,486~~; Aaron Weissluch, Reg. No. ~~41,557~~; Edward J. Wise, Reg. No. ~~34,523~~; Alexander V. Yampolsky, Reg. No. ~~36,324~~; and Robert W. Zelnick, Reg. No. ~~36,976~~, all of McDermott, Will & Emery.

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203	Full Name of Inventor	Family Name	First Given Name	Second Given Name
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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that wilful false statements and the like so made are punishable by fine or imprisonment, or both, under section 1001 of Title 18 of the United States Code, and that such wilful false statements may jeopardize the validity of the application or any patent issuing thereon.

Signature of Inventor 201:	Signature of Inventor 202:	Signature of Inventor 203:
Date: 8 May 02	Date:	Date: